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(54) **DIGITAL BROADCASTING RECEIVER**

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(52) **U.S. Cl.** **375/340**; 709/104; 455/186.1; 375/349
(58) **Field of Search** 375/340, 349, 375/260, 316; 455/418, 419, 3.2, 4.2, 6.1, 188.1, 190.1, 337, 133, 140, 141, 186.1; 709/104

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(57) **ABSTRACT**

A digital broadcasting receiver capable of receiving a plurality of types of digital broadcasting, for example, digital satellite broadcasting, digital ground wave broadcasting and digital CATV broadcasting. The digital broadcasting receiver includes a software utilizing demodulating section for demodulating a digitized intermediate-frequency signal, a memory for storing software to be used in the software utilizing demodulating section so that each digital broadcasting capable of being received is demodulated, and a control section for giving a command to the software utilizing demodulating section so that the software for demodulating each digital broadcasting is selectively used by the software utilizing demodulating section according to a setting made by a remote control transmitting unit or a key input section which is a setting input section.

3 Claims, 2 Drawing Sheets

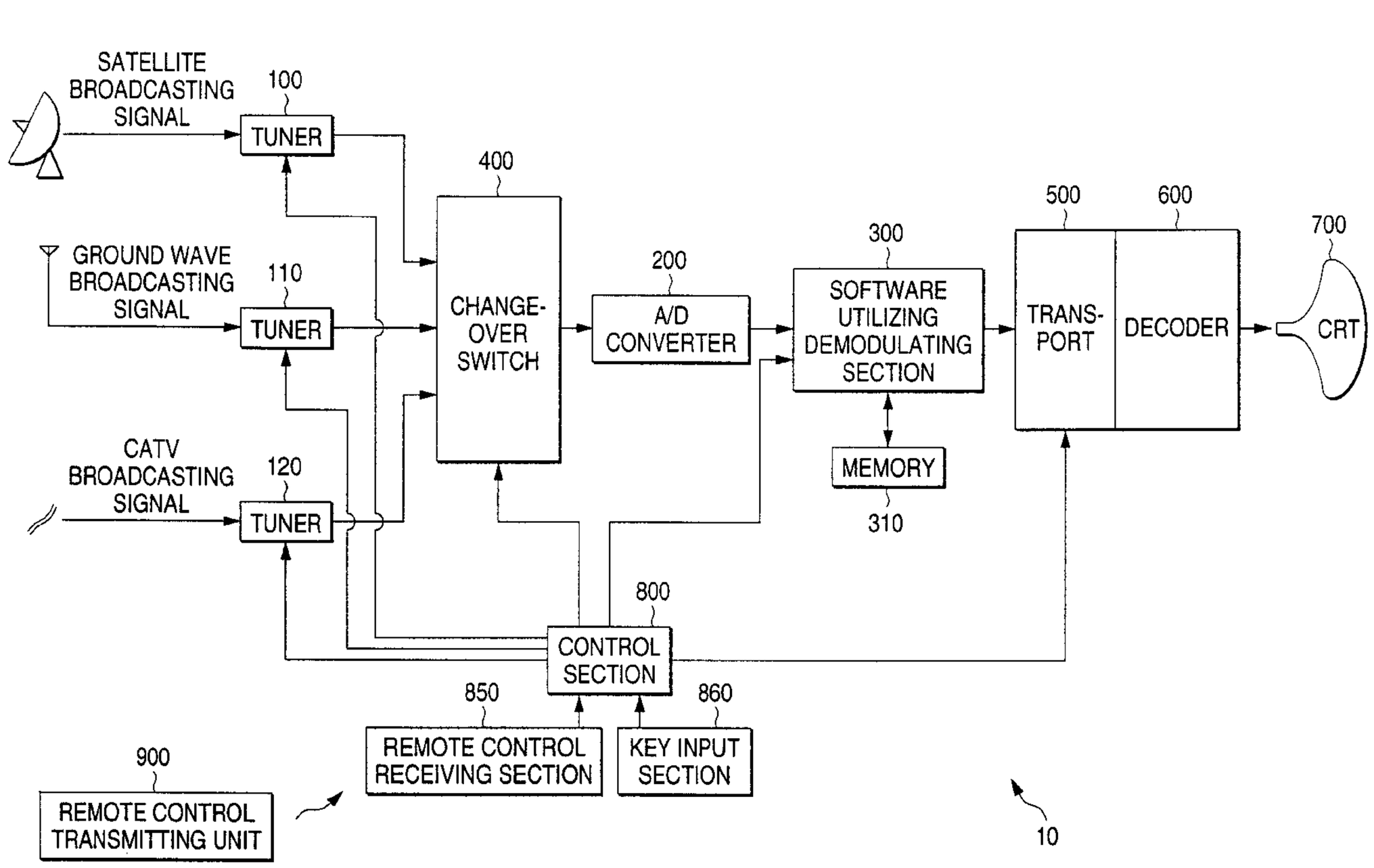


FIG. 1

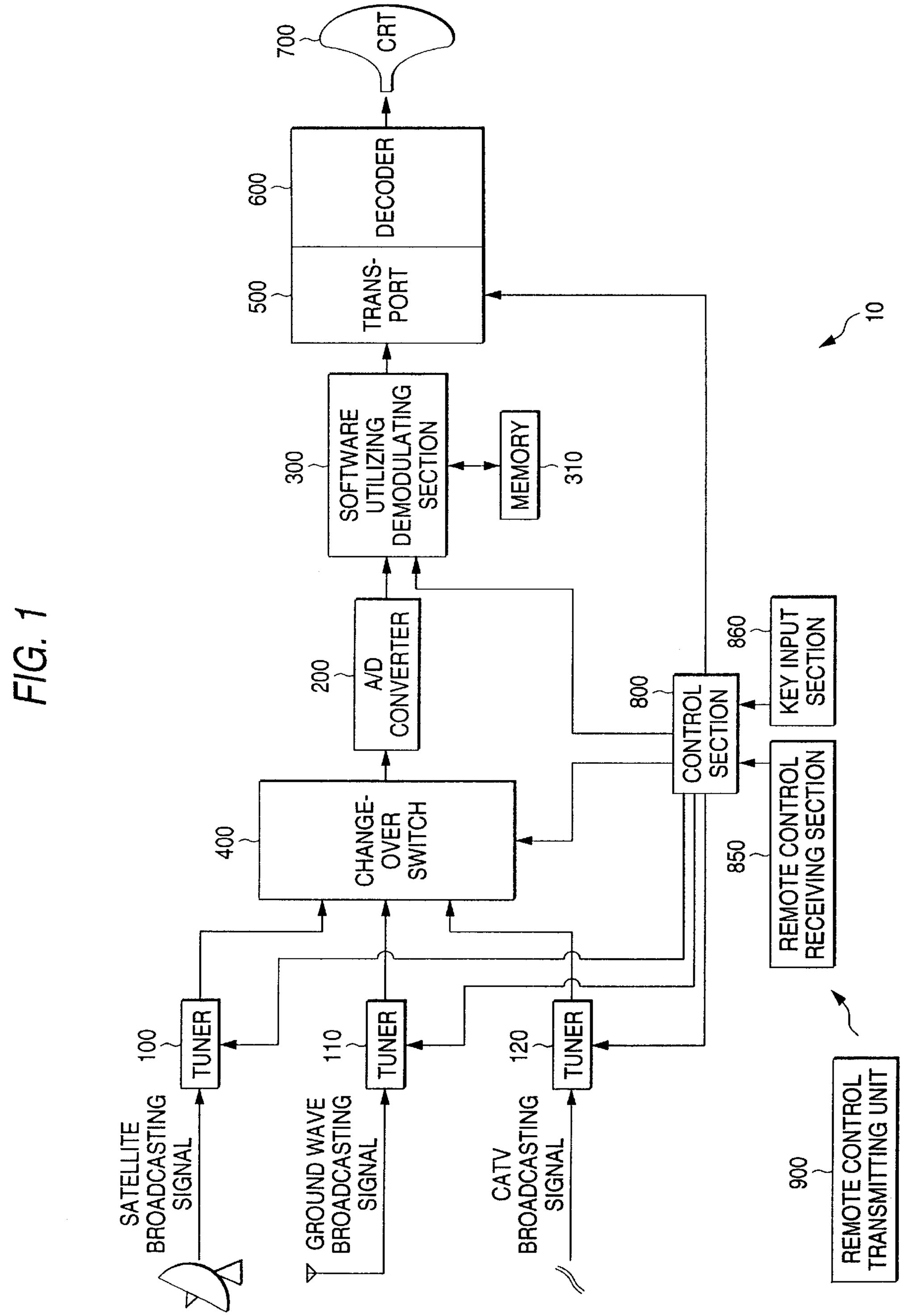
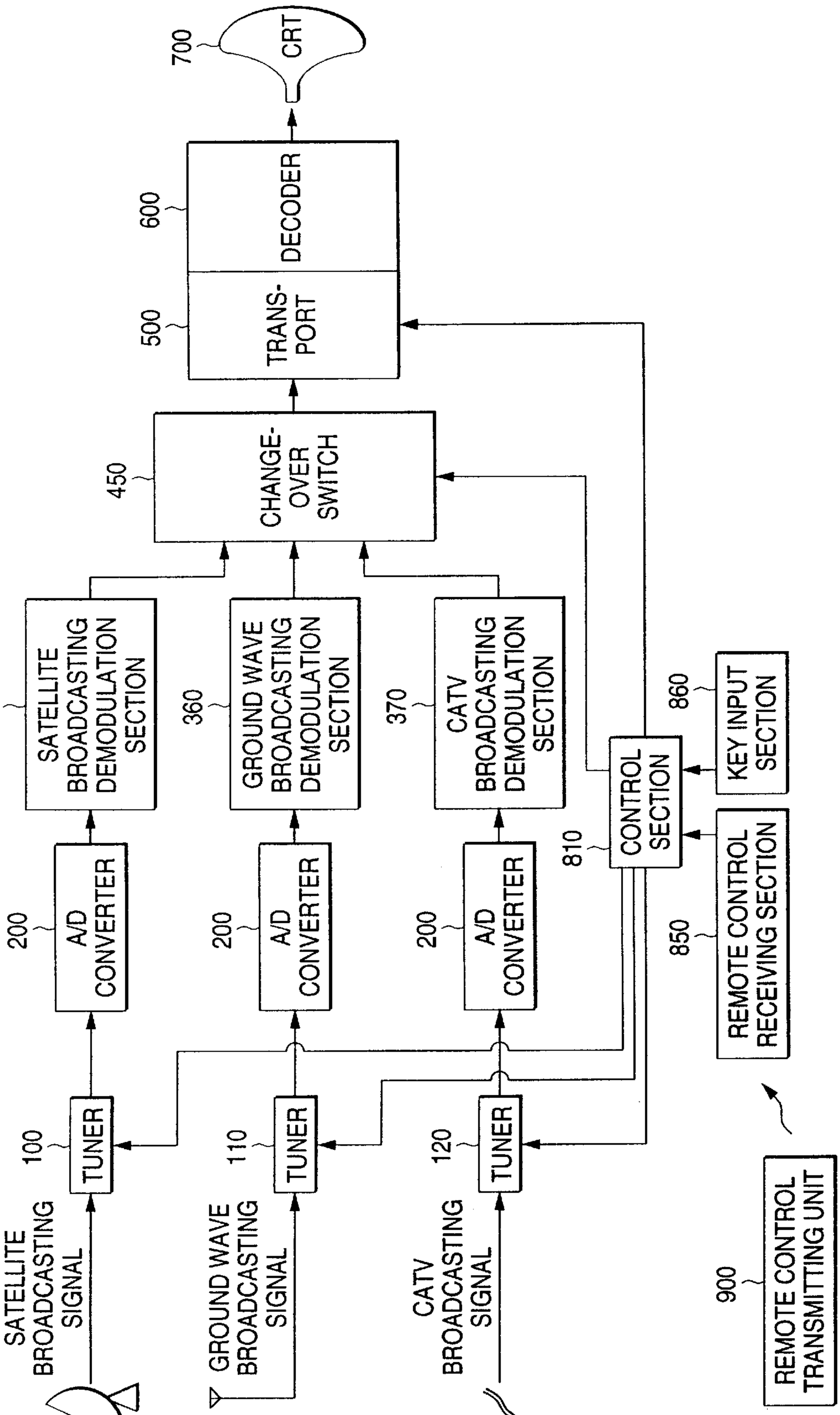

700
CRT
600
DECODER
500
TRANS-PORT
300
SOFTWARE UTILIZING DEMODULATING SECTION
MEMORY
310
200
A/D CONVERTER
400
CHANGE-OVER SWITCH
10
800
CONTROL SECTION
860
KEY INPUT SECTION
850
REMOTE CONTROL RECEIVING SECTION
100
TUNER
110
TUNER
120
TUNER
SATELLITE BROADCASTING SIGNAL
GROUND WAVE BROADCASTING SIGNAL
CATV BROADCASTING SIGNAL
900
REMOTE CONTROL TRANSMITTING UNIT

FIG. 2
PRIOR ART



DIGITAL BROADCASTING RECEIVER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital broadcasting receiver capable of receiving signals of not less than two types of digital broadcasting among digital satellite broadcasting, digital ground wave broadcasting and digital CATV broadcasting.

2. Description of the Related Art

As shown in FIG. **2**, a conventional digital broadcasting receiver includes: a tuner **100** for converting a digital satellite broadcasting signal into an intermediate-frequency signal; a tuner **110** for converting a digital ground wave broadcasting signal into an intermediate-frequency signal; a tuner **120** for converting a digital CATV broadcasting signal into an intermediate-frequency signal; A/D converters **200**, **200**, **200** for digitizing the intermediate-frequency signals respectively sent from the tuners **100**, **110**, **120**; a satellite broadcasting demodulating section **350** for demodulating a digital signal sent from the first A/D converter **200**; a ground wave broadcasting demodulating section **360** for demodulating a digital signal sent from the second A/D converter **200**; a CATV broadcasting demodulating section **370** for demodulating a digital signal sent from the third A/D converter **200**; a changeover switch **450** for selecting one of the signals sent from the satellite broadcasting demodulating section **350**, the ground wave broadcasting demodulating section **360** and the CATV broadcasting demodulating section **370**; a transport **500** for separating and dividing the signal selected by the changeover switch **450**; a decoder **600** for decoding the signal sent from the transport **500**; and a CRT **700** for displaying an image of the signal sent from the decoder **600**.

The conventional digital broadcasting receiver **5** further includes: a control section **810** for controlling the tuners **100**, **110**, **120**, the changeover switch **450** and the transport **500**; a key input section **860** which is one of the setting input sections of the control section **810**; and a remote control receiving section **850** for receiving the signals sent from a remote control transmitting unit **900** which is the other setting input section and which is provided separately from the digital broadcasting receiver **5**.

For example, as disclosed in Japanese Patent Unexamined Publication No. Hei. 6-54011, a QPSK demodulating circuit of the satellite broadcasting demodulating section **350**, by which a pure demodulating function can be exhibited, includes: five multipliers; three filters; a 90° phase shifter; a voltage-controlled oscillator; a clock regenerating circuit; two waveform shaper; and a subtracter, wherein all of them can be realized as digital circuits.

Of course, an error corrector, which is the residual function of the satellite broadcasting demodulating section **350**, can be also realized as a digital circuit.

On the other hand, although not described in the above publication, the ground wave broadcasting demodulating section **360** is composed of an 8-value VSB demodulator or an OFDM demodulator and an error corrector, wherein all of them can be realized as digital circuits. The CATV broadcasting demodulating section **370** is composed of a 16-value VSB demodulator or a 256-value QAM demodulator and an error corrector, wherein all of them can be realized as digital circuits.

In the above publication, attention is paid to a portion of hardware which is common between the QPSK demodulating circuit and the MSK demodulating circuit, and a method of reducing hardware is disclosed as an invention.

However, in the conventional digital broadcasting receiver **5** composed in the manner described above, the satellite broadcasting demodulating section **350**, the ground wave broadcasting demodulating section **360** and the CATV broadcasting demodulating section **370** are required respectively for receiving digital satellite broadcasting, ground wave broadcasting and CATV broadcasting. Therefore, the number of necessary parts is necessarily increased and the manufacturing cost is raised.

When the method described in the above publication is adopted to reduce hardware, it is possible to decrease the number of necessary parts and reduce the manufacturing cost, however, the decrease of the number of necessary parts is limited because attention is paid only to hardware.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a digital broadcasting receiver, the number of necessary parts of which is decreased so that the manufacturing cost can be reduced.

In order to achieve the above object, the present invention provides a digital broadcasting receiver capable of receiving a plurality of types of digital broadcasting, comprising: a software utilizing demodulating section for demodulating a digitized intermediate-frequency signal; a memory for storing software to be used in the software utilizing demodulating section so that each digital broadcasting capable of being received is demodulated; and a control section for giving a command by which the software to demodulate each digital broadcasting is selectively taken from the memory into a memory which is built in the software utilizing demodulating section according to a setting made by a setting input section.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram schematically showing a digital broadcasting receiver of an embodiment of the present invention.

FIG. **2** is a block diagram schematically showing a conventional digital broadcasting receiver.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1**, an embodiment of a digital broadcasting receiver of the present invention will be described below.

FIG. **1** is a block diagram schematically showing a digital broadcasting receiver of the embodiment.

In this connection, like reference numerals are used to designate like parts which are common between the digital broadcasting receiver of this embodiment and the conventional digital broadcasting receiver **5**.

The digital broadcasting receiver **10** includes: a tuner **100** for converting a digital satellite broadcasting signal into an intermediate-frequency signal; a tuner **110** for converting a digital ground wave broadcasting signal into an intermediate-frequency signal; a tuner **120** for converting a digital CATV broadcasting signal into an intermediate-frequency signal; a changeover switch **400** for selecting one of the intermediate-frequency signals sent from the tuners **100**, **110**, **120**; an A/D converter **200** for digitizing the signal selected by the changeover switch **400**; a software utilizing demodulating section **300** for demodulating (detecting) a

digital signal sent from the A/D converter **200**; a memory **310** attached to the outside of the software utilizing demodulating section **300**; a transport **500** for separating and dividing the signal sent from the software utilizing demodulating section **300**; a decoder **600** for decoding the signal sent from the transport **500**; and a CRT **700** for displaying an image of the signal sent from the decoder **600**.

The digital broadcasting receiver **10** further includes: a control section **800** for controlling the tuners **100**, **110**, **120**, the changeover switch **400**, the software utilizing demodulating section **300** and the transport **500**; a key input section **860** which is one of the setting input sections of the control section **800**; and a remote control receiving section **850** for receiving signals sent from a remote control transmitting unit **900** which is the other setting input section and which is provided separately from the digital broadcasting receiver **10**.

The software utilizing demodulating section **300** is composed of a device such as a DSP which performs digital signal processing at a very high speed and which has a function of a sum of product computing unit or the like which is especially required when a filter necessary for demodulation is realized by a-digital filter.

Such a DSP used as the software utilizing demodulating section **300** is provided with a built-in memory (not shown in the drawing).

The memory **310** is a non-volatile memory or a mask ROM. In the memory **310**, there are previously set software (not. shown) for demodulating the signals of digital satellite broadcasting, software (not shown) for demodulating the signals of digital ground wave broadcasting, and software (not shown) for demodulating the signals of digital CATV broadcasting.

Software,(not shown) for demodulating the signals of digital satellite broadcasting is for example, software which operates on the DSP in the same manner as that of a QPSK demodulator and an error corrector. Software (not shown) for demodulating the signals of digital ground wave broadcasting is for example, software which operates on the DSP in the same manner as that of an 8-value VSB demodulator or an OFDM demodulator and an error corrector. Software (not shown) for demodulating the signals of digital CATV broadcasting is for example, software which operates on the DSP in the same manner as that of a 16-value VSB demodulator or a 256-value QAM demodulator and an error corrector.

The control section **800** is for example, a common TV microcomputer.

The-remote control transmitting unit **900** is provided with common keys such as broadcasting selection keys (not shown) for selecting one of satellite broadcasting, ground wave broadcasting and CATV broadcasting and channel keys for selecting one of the channels.

The operation of the digital broadcasting receiver **10** composed in the above-described manner will be described below when the digital broadcasting receiver **10** is operated by the remote control transmitting unit **900** which is usually used as a primary setting input section.

For example, when satellite broadcasting is selected by the broadcasting selection keys (not shown) of the remote control transmitting unit **900**, the remote control transmitting unit **900** makes a signal for broadcasting selection, and superimposes a carrier wave on the signal, and transmits a carrier-wave-superimposed signal for broadcasting selection. The remote control receiving section **850** receives the carrier-wave-superimposed signal for broadcasting selection and returns it into the signal for broadcasting selection from which the carrier wave is removed. The resultant signal is sent to the control section **800**.

The control section **800** gives a command to the software utilizing demodulating section **300**, by which software (not shown) to demodulate the signals of digital satellite broadcasting stored in the memory **310** can be taken into (loaded on) the built-in memory of the software utilizing demodulating section **300**. In this connection, when the software utilizing demodulating section **300** takes software (not shown) for demodulation into the built-in memory, the contents in the built-in memory are previously erased.

The control section **800** directs the changeover switch **400** so that the changeover switch **400** can be set on the tuner **100** side.

Thereafter, when a channel is selected by the channel keys (not shown) of the remote control transmitting unit **900**, the remote control transmitting unit **900** makes a signal for channel, superimposes a carrier wave on this signal, and transmits a carrier-wave-superimposed signal for channel. The remote control receiving section **850** receives the carrier-wave-superimposed signal for channel, and returns it into the signal for channel from which the carrier wave is removed. The resultant signal is sent to the control section **800**.

According to the signal for channel, the control section **800** determines a channel group containing the channel and sends a predetermined PLL signal corresponding to the channel group to the tuner **100**.

When the tuner **100** receives this predetermined PLL signal, it converts the channel group from the satellite broadcasting signal into an intermediate-frequency signal.

The intermediate-frequency signal is digitized by the A/D converter **200** and sent to the software utilizing demodulating section **300**.

Since software (not shown) for demodulating the signals of satellite broadcasting has already been set in to the software utilizing demodulating section **300**, a predetermined demodulation including an error correction can be performed.

The thus demodulated signal is sent to the transport **500**. In the transport **500**, signals of the unnecessary channels are removed from the signals of the channel group according to the signal for channel sent from the control section **800**, and at the same time, signal of the necessary channel is extracted.

The thus extracted signal is sent to the decoder **600** and decoded. The decoded signal is sent to the CRT **700**.

Due to the foregoing, a program of the predetermined channel of satellite broadcasting, which has been selected by the remote control transmitting unit **900**, is displayed on the CRT **700**.

According to the above operation, not only satellite broadcasting but also ground wave broadcasting and CATV broadcasting can be selected in the same manner. Therefore, the description thereof is omitted here.

As described above, a period of time of at least one second is left from the selection of a type of broadcasting to the selection of a channel conducted by the remote control transmitting unit **900**, and a size of software (not shown) to for demodulation for each broadcasting is relatively small. Therefore, no problems are caused when software (not shown) used for demodulation is taken into (loaded into) the built-in memory of the software utilizing demodulating section **300**.

Incidentally, in the digital broadcasting receiver **10** of the present invention, when the capacity of the built-in memory of the software utilizing demodulating section **300** is sufficiently large to hold the overall software (not shown) used for demodulation for each broadcasting, the contents of the memory **310** are taken (loaded) into the built-in memory of the software utilizing demodulating section **300**, for example, when the power supply of the digital broadcasting receiver **10** is turned on. In this case, software for demodulation for each broadcasting is formed into a subroutine (block) for each broadcasting. When a command of directing software to be carried out for demodulation for one broadcasting is given to the software utilizing demodulating section **300** by the control section **800**, only software for demodulation for that broadcasting is carried out.

Further, when the built-in memory of the software utilizing demodulating section **300** is a nonvolatile memory such as a flash memory or a mask ROM, software for demodulation for each broadcasting is previously set in the built-in memory when the digital broadcasting receiver **10** is shipped from a factory. In this case, the reading speed of a nonvolatile memory such as a flash memory or a mask ROM is not sufficiently high and therefore, a cache memory may be incorporated into the software utilizing demodulating section **300** as a built-in memory in addition to a nonvolatile memory or the like.

In the digital broadcasting receiver **10** of the present invention, the memory **310** may be arranged in the control section **800** or on the side of the control section **800**.

In the digital broadcasting receiver **10** of the present invention, the software utilizing demodulating section **300** is a DSP, however, as long as the same performance can be exhibited, RISC, CISC or other ASCI may be used for the software utilizing demodulating section **300**.

In the digital broadcasting receiver **10** of the present invention, the control section **800** is composed of a TV microcomputer, however, it is possible to use exclusive hardware for controlling at least the software utilizing demodulating section **300**. Further, when the processing capacity of the software utilizing demodulating section **300** itself is sufficiently large, a portion or all of the functions of the control section **800** may be incorporated into the software utilizing demodulating section **300**.

The CRT **700** is built in the digital broadcasting receiver **10** of the present invention so that it can be used as an image displaying device, however, the digital broadcasting receiver **10** of the present invention may be formed into a receiver, which does not include the CRT **700**, to be connected with a monitor display or a common analog TV set.

Further, such a receiver not including the CRT **700** may be applied to the tuner section of a VCR.

Furthermore, the digital broadcasting receiver **10** of the present invention may be formed into a TVCR in which a VCR is built.

In the above description, the digital broadcasting receiver **10** of the present invention receives three types of digital broadcasting. However, it is possible to provide a digital broadcasting receiver capable of receiving two types or not less than four types of digital broadcasting in the same manner as that described above. Accordingly, the description thereof is omitted here.

As described above, the present invention provides a digital broadcasting receiver capable of receiving a plurality of types of digital broadcasting, comprising: a software utilizing demodulating section for demodulating a digitized intermediate-frequency signal; a memory for storing software to be used in the software utilizing demodulating section so that each digital broadcasting capable of being received is demodulated; and a control section for giving a command by which the software to demodulate each digital broadcasting is selectively taken from the memory into a memory built in the software utilizing demodulating section according to a setting made by a setting input section.

Therefore, in the digital broadcasting receiver of the present invention, only one software utilizing demodulating section is used while the conventional receiver uses a plurality of demodulating sections which are respectively required for the types of digital broadcasting to be received. When the software utilizing demodulating section selectively takes software for demodulation corresponding to the type of digital broadcasting to be received, from the memory in which three types of software for demodulation is stored, the function of demodulating the digital broadcasting concerned is exhibited.

Therefore, the number of necessary parts of the digital broadcasting receiver of the present invention can be made to be smaller than that of the conventional digital broadcasting receiver. Due to the foregoing, the manufacturing cost of the digital broadcasting receiver can be reduced, and also the size and weight thereof can be decreased.

What is claimed is:

1. A digital broadcasting receiver capable of receiving a plurality of types of digital broadcasting, comprising:

a software utilizing demodulating section for demodulating a digitized intermediate-frequency signal;

a memory for storing a plurality of software corresponding to the plurality of types of digital broadcasting to be used in said software utilizing demodulating section so that each digital broadcasting capable of being received is demodulated; and

a control section for giving a command by which the software to demodulate each digital broadcasting is selectively taken from said memory into a memory which is built in said software utilizing demodulating section according to a setting made by a setting input section.

2. The digital broadcasting receiver according to claim **1**, wherein said memory and said software utilizing demodulating section are integrated with each other, and said control section gives a command to said software utilizing demodulating section so that the software to demodulate each digital broadcasting is selectively used.

3. The digital broadcasting receiver according to claim **1**, further comprising a plurality of tuners corresponding to the plurality of types of digital broadcasting, a changeover switch for selecting one of intermediate-frequency signals sent from said tuners, and an A/D converter for digitizing the intermediate-frequency signal selected by said changeover switch to send the digitized intermediate-frequency signal to said software utilizing demodulating section.

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